# Solar Panels

## Build Your Own

Instructions for the Do It Yourself Person
Let's have some fun!

Before we get started lets talk about a few things like materials and tools. Let's start off with tools as Lowes and Home Depot are very close to my heart.

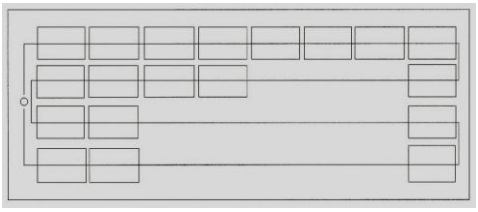
**Tools:**

The tools required are not many and most of what is needed you may have already.

1. Pencil type soldering iron (Nothing big and bulky as you can't feel what you are doing) with a copper tip (25 Watt not less). Radio Shack has a good one with replaceable tips.
2. Digital Multi Meter – Radio Shack Cat #22-811 will do the trick nicely with leads. You also may want to pick up a set of 4 leads with alligator clips. They will come in handy when testing the cells. You won't need 4 hands.
3. Side cutters and wire stripper will make life easier when working with the wire and tabbing.
4. Liquid flux pen is a must. On line (e-Bay) Rosin Flux Pen by MG Chemicals Cat #835-P 40ml. You can control this. The others are messy and the liquid flux in a bottle runs all over.
5. Solder – I like Qualitex 60/40 1/32 Dia with .7% flux this solder works well and has low residue. The Radio Shack Solder 60/40 works well too. This brings me to a point worth mentioning actually several. One – Your soldering iron **MUST BE HOT** when soldering. If your solder does not melt instantly when touched to the point of the soldering pen-It is not hot enough and no amount of pressure on the point will help but instead may break the very delicate solar cells. Two – There will be dross build up that will form on the point of the soldering pen. You can do one of two things to get rid of the dross. Remove and replace the point or take some emery paper and lightly sand the point thus removing the dross from the pens tip.
6. Cell and Buss tabbing wire- Tin coated. You can find this on e-Bay.
7. Dow Corning PV 804 Solar Panel Frame Adhesive Sealant. This will be used to mount the cells, sealing the edges of the panel, gluing the risers around the outside edge of the panel and mounting the aluminum edging or frame. One tube should do it. You will also need a standard caulking gun to apply the sealant.
8. Wire – Red and Black wire 18 gauge should work well in this application. The red wire will be used on the + side and the black will be - . You will also need a plastic covered junction box about 2 in Wide X 3in Long X 1in deep (Radio Shack)
9. Work area – A large table – Not your dining room table! More like a 4'X8' Sheet of plywood with sturdy legs – Perfect!
   That's about it for the tools.

## Materials:

Your solar panel will be a shallow box. The one that I have in mind is 15 ½ Inches Wide X 43 Inches long. With 3/16 X ¾ inch wide risers these will be glued to the white back panel.

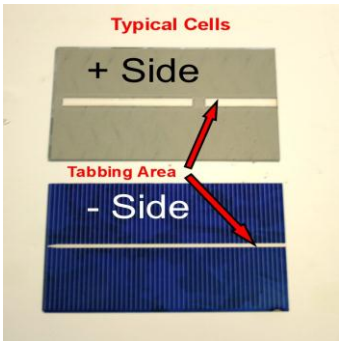


When finished the clear panel will be glued to the top of the risers.

The material for the shallow box could be wood, fiberglass or just about any non conductive material. How ever the material that will do the best all around is Plexi Glass (Lucite **CP Acrylic Sheet)**. Not the cheapest but the best.

Backing should be ¼ Inch White 3/16 thick risers (3) required and should be ¾ Inch wide by 48 Inches Long. They will be cut with a saber saw later. The front should be 3/16 or ¼ Inch Clear Plexiglas with **NO UV Blocker**. Don't want to stop the rays. You will also need aluminum C-Channel 1/8 X 3/4"Legs X 7/8" High Back (Home Depot). Your panel will fit inside the (C) More about this later.

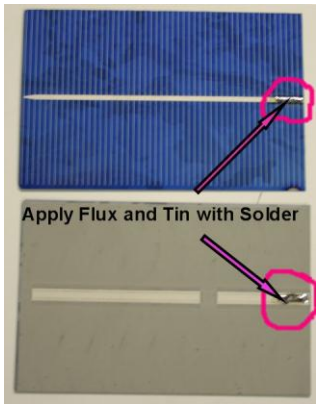
You can use any cells. The cells can have 1 or 2 bus bars (What you solder to). Generally the more expensive cells are a higher quality and produce more energy. Keep in mind that to charge a standard 12 volt battery you will want to generate about 17 volts so add up the voltage of your cells that you are going to buy and design your panel back around that quantity. The cells that we will be using are 3 In Wide X 4 ¾ High and the bus bar runs in the center of the 4 and ¾ height and are as pictured above. A 32 Cell panel is a good number to charge a 12 volt battery providing you get 17 volts in full sun.

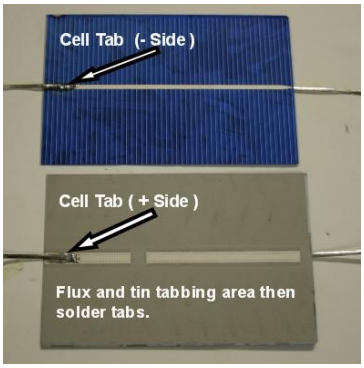


Once you have your cells you need to lay out a template to see how they will fit. Keep ¼ inch between cells both horizontally and vertically leave 1 and ½ inches on the sides and 2 and ½ inches at the top, at the bottom leave 2 inches. At the top about 2 inches down and in the center of the panel width mark a spot for a ¼ inch whole. The 2 wires will go thru this hole into a junction box that you will mount on the outside of the back panel and will be done last. This is now the mock up for the white plexi glass back panel. Once you are satisfied with the lay out transfer it to the white Plexiglas. Do not drill the ¼ inch hole yet.
Keep in mind that about 3/4 inch of the outer perimeter of the Plexiglas panel will be covered by aluminum C-Channel.

## Tinning the Cells and Tabbing.

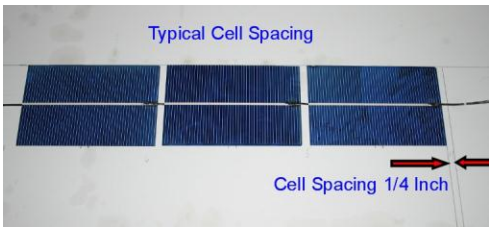
Apply flux from your flux pen to the areas of the cell that you will solder to apply a little solder so that your soldered area is about 3/8 inch long. You will solder the tabbing to these areas. You will need to tin the tabbing wire as well. I usually do about 4 inches at a time and cut pieces as I need them and final trim lengths when attaching the second cell.

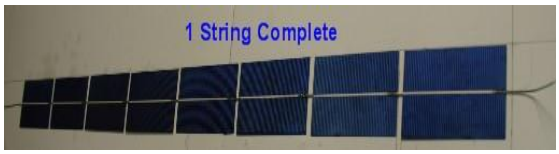



## Cell String Lay Out:

Leaving ¼ inch between cells you attach the cells front (-) to back (+) continue this to form a string of 8 cells. I check each cell as I go making sure that I get a good voltage reading as I go. You will get a voltage reading even in artificial light.

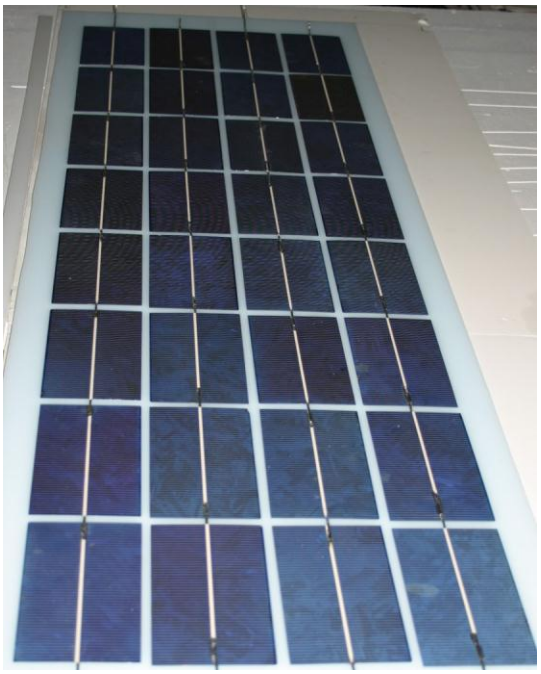





Once you have your (4) strings of (8) cells per string you can now lay them out on your white Plexiglas where they will be glued into place with the tube of PV 804 Solar Sealant (Silicone).

## Panel Lay Out:

Lay your cells so that there is ¼ inch between strings and your spacing top and bottom are as previously described.
**Neatness Counts!**



When you lay out the cell strips on the white plexi use a Dry Erase Pen as the marks can be carefully removed with a q-tip when done.

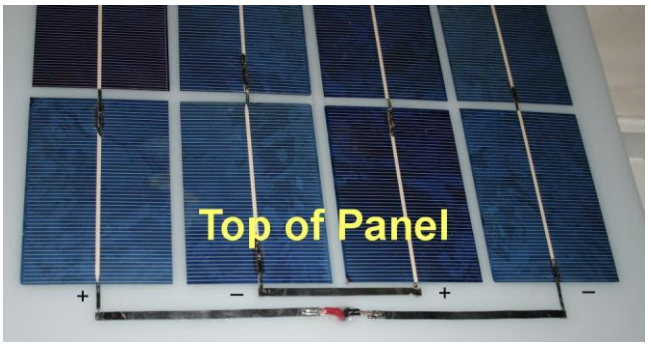
Please look at the lay out sketch. Please note where the pluses and minuses are laid out, don't forget that the tabs of the back side of the cells are PLUS and the ones coming off the front side are MINUS. This is very important as the cells all need to be connected in the proper manner with the Bus Tabbing later. See below illustration.

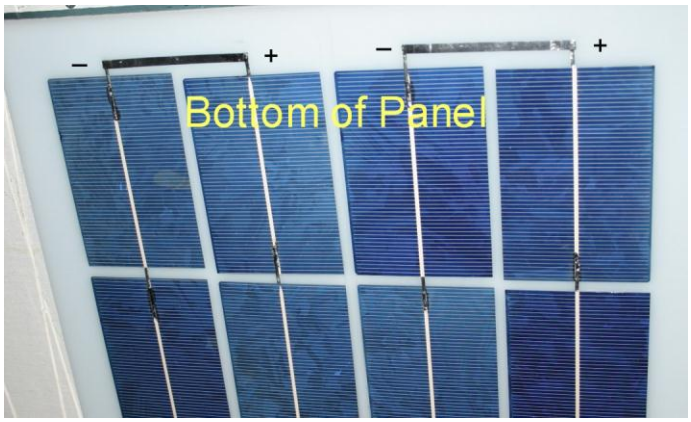
Mounting the Strings of Cells:

**Gluing the cells down:** **You may want to practice this as you will be gluing the entire string of cells at one time.** When marking the cell placement, you will also have to mark the centerline of the bus strips as this is the centerline of the cells. You will also need to mark the beginning and end of each cell. You can place these marks just inside of the cell area. You will want to apply a 1-2 inch bead of 804 PV sealant on the centerline of each cell and situated in the center of each cell. You will have (8) beads of PV Sealant. You will now lay down your first string of cells on the sealant. You will **VERY LIGHTLY** press on the cell just lightly pushing it into the sealant. Once you do this to each cell leave it alone and move on to the next string. The object is to set all the cells with out cracking one. If you do crack a cell the entire string must be removed and the cracked cell removed and replaced.

**Connecting the Cell Strings.**

Look at the pictures and you will see that the wide Bus Tabbing is used to connect the cell strings together. Keep your tabbing and bus tabbing as neat as possible as this will be seen through the front clear plexi.

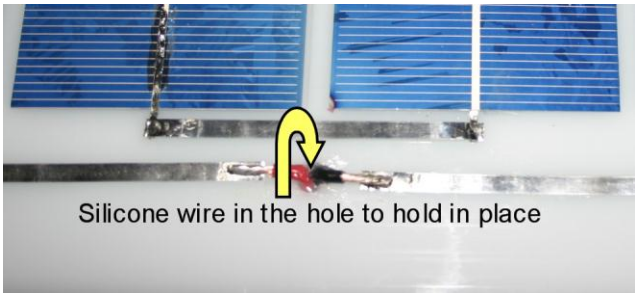





Keep at least ¼ Inch between the tabbing and the edges of the cells. Keep the tabbing at least ¼ inch away from each other as well. The tabbing can be siliconed to the back panel if needed. Clear silicone works well for this. Keep it clean and neat, no smears.

## Wiring.

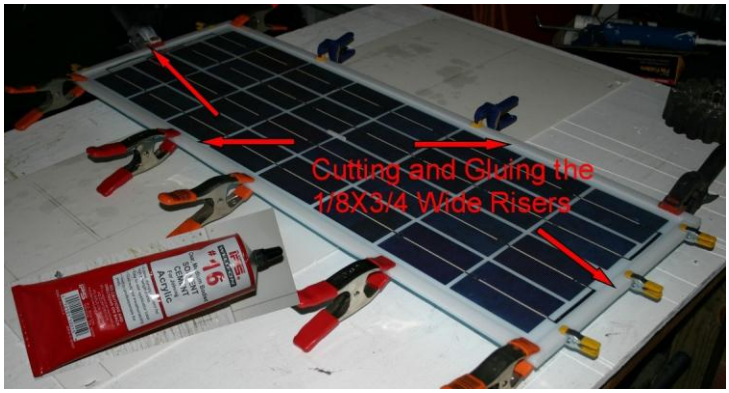
18 Gauge wire should work well. Cut (1) Red and (1) Black about 6 Inches long each. Strip back one end about 3/8 of an inch and tin the wire with solder.
Drill your 5/16 hole about 1.5 inches down from the top of the plexi and in the center of the 15.5 Inch width dimension. Your wire will exit thru this hole toward the back. Take your red wire and solder it to the + bus bar and the same with the Red connecting it to the – bus bar. Look at the pictures, if you measure everything out and eye everything up all should connect and look good. Make your adjustments as necessary and solder the wires to the tabbing. Carefully silicone the tabbing to the back panel and the wires in the hole.




Once this is complete and the silicone is set up we can go on to the next step.

## Mounting the side risers:

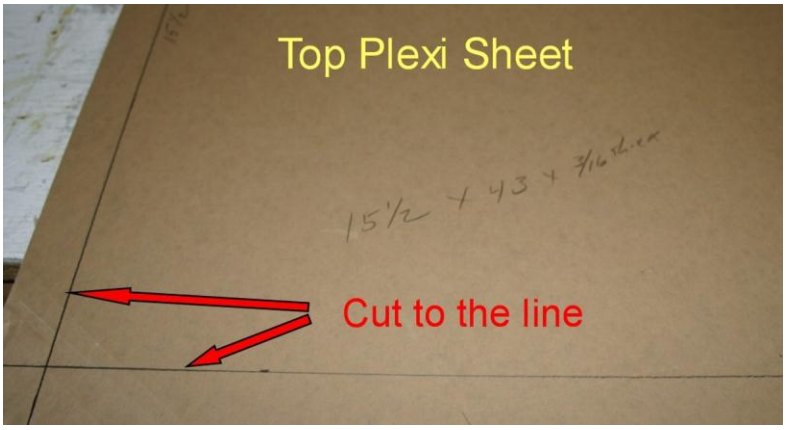
In this case your side risers are 1/8 inch thick by ¾ inch wide. They are cut to the length of the Plexiglas and the width is in this case would be 14 inches as these pieces fit inside the outer strips. The strips are glued down with either the PV Cement or the Plexiglas glue and are held in place by spring clamps until the glue is cured, which is about 12 hours. Take note of the small piece of plexi in the center of the panel it is also glued to the back panel. This serves as a support for the front clear plexi panel and does not get glued to the front clear panel.




Once this is complete and the glue has dried we can move on to mounting the clear face panel.

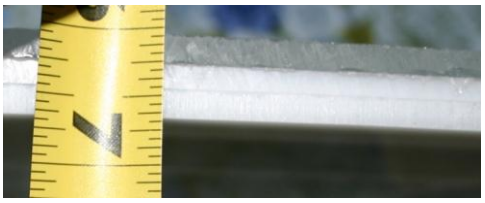
## Clear Face Panel Mounting:

The clear plexi usually comes with a paper backing so as not to get scratched. This backing can also serve as lay out paper. Once you have transferred your sizes to the paper the Plexiglas can be cut with a saber saw. See picture.

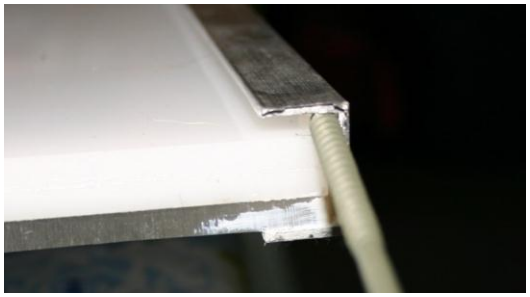



Once the plexi is cut, remove the paper from one side. The glue can be added to the top of the risers (Not Center Support). The plexi then can be mounted with paper side up. Carefully clamp in place using 4 clamps on each side and 3 clamps on each end. Let set over night. Then remove the clamps and paper.

## Aluminum Side Frame:



The total thickness of all the layers of Plexiglas should be around 5/8 of an inch. The Aluminum C-Channel is what will be used for the frame. The corners can be mitered or notched. I prefer notched as cutting a 45 degree miter by hand is hard to do and can look bad if not done exactly.
Cut the 15.5 inch long end pieces first and glue them in place with the 804 PV sealant. Keep the inside edge of the C-Chanel against the clear panel face. To keep it positioned use a couple of screws or nails wedged between the back panel and the inside leg of the c-Channel.



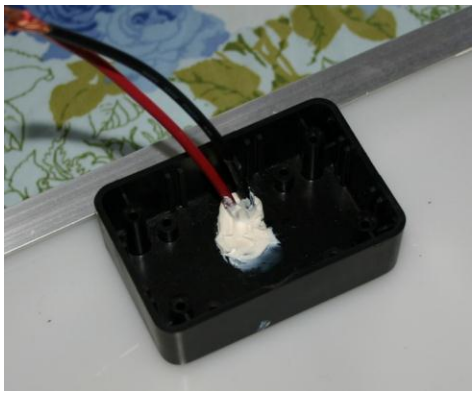
Cut and glue both ends and let sit over night before starting the side pieces.

Cut the side pieces to full length of sides to include the end frames. Lay out and saw the end notches being careful to fit parts closely together.
Once parts are fitted they can be glued in the same manner utilizing a clamp in the center and again using screws to keep the C-Channel leg pulled tight to the clear plexi.

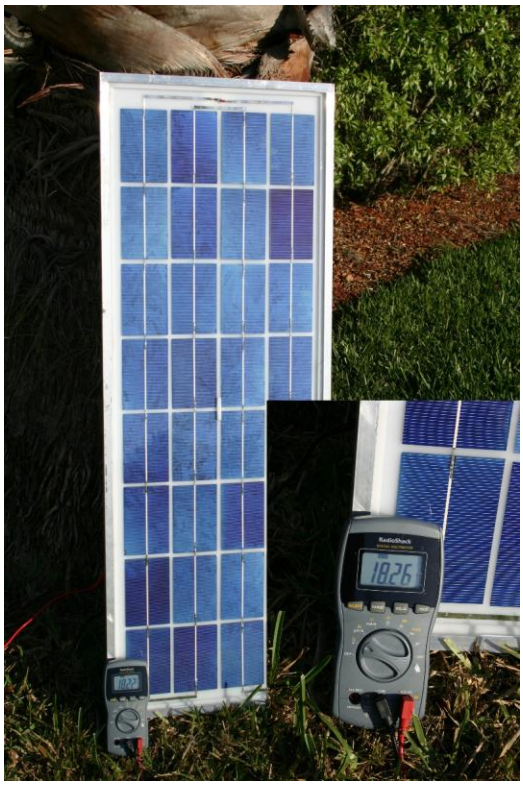
## Mounting the Junction Box:

The junction box is nothing more than a plastic box with a cover that can be screwed down tight. These boxes can be found at places like Radio Shack and are not expensive. They give the project a professional look and are functional as far as keeping moisture out of the wire connections. You will have to drill a 3/8 hole in the back of the box for the wires to enter. Placement of the hole will be determined by the location of the 4 pole

terminal strip that will be glued to the inside of the box as well. This also is a Radio Shack item. Once the hole is drilled place PV 804 on the outside back of the box and feed the wires thru to the inside and locate the box on the plexi. Take the PV Cement and seal the wire and hole. Take the terminal strip and put a bead of PV Cement on the back and mount it inside the box. Do this in such a manner as to be able to attach the Solar Panel wires to one side and the exit wires to the other side. Drill the exit wire hole when you know where you want the wires to exit. Let the entire unit set up over night to cure.



## Time to test the panel




# Ya – Hoo !!!!!!!!!!!!!!! It works !

**We were looking for 17 volts and in the afternoon sun got 18.26**
**Not to shabby! It was fun too! All that you need is a voltage regulator and you can charge a 12 volt battery.**

**Project Complete.**